Description of *Meloidogyne suginamiensis* n. sp. (Nematoda: Meloidogynidae) from Mulberry in Japan

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A root-knot nematode, *Meloidogyne suginamiensis* n. sp. from mulberry (*Morus alba*) in Tokyo, Japan, is described and illustrated. This new species differs from *M. mali* in the female perineal pattern having the slightly squarish outline, wavy striae (oval outline, smooth striae in *M. mali*); the shorter the more broad tail of the second-stage larvae (24-33μm vs. 30-34μm and 30-40μm long of the original description and of the populations of *M. mali* from mulberry, respectively); and differentiating characteristics of face view of the second-stage larvae as well as of the males in observation by scanning electron microscope. *M. suginamiensis* n. sp. can also be separated from *M. mali* in parasitizing on not only woody plants but on various kinds of herbaceous plants. *Jpn. J. Nematol.* **14**: 49-57 (1984).

The nematode fauna of mulberry fields have been investigated during past ten years by TOIDA *et al*[9,10], who reported that most of known species of the root-knot nematodes in Japan were parasitic to mulberry. They include *M. mali*, *M. javanica*, *M. arenaria*, *M. incognita* and *M. hapla*. TOIDA and his colleagues[10,11] suggested that the root-knot nematode regarded as *M. mali* from mulberry in the small area of Suginami, Tokyo, where the Sericultural Experiment Station was formerly situated, somewhat differed from the species of the original description[4] in shorter tails of the second-stage larvae as well as in the parasitism to herbaceous plants. OKAMOTO *et al*[8] also reported that the population of *M. mali* from Suginami could be distinguished from both populations from apple in Misato, Nagano Prefecture and from mulberry in several localities in the face view of the males and the second-stage larvae by SEM observation, tail shape of the second-stage larvae, and the female perineal pattern. Although these reports suggested that the root-knot nematode from Suginami had some characteristics differentiating from *M. mali* it has not been decided whether the nematode was *M. mali* or not.

The authors comparatively examined the morphology and host plant reaction to the population from mulberry of Suginami and other localities, and from apple in Misato, Nagano Prefecture, 60km south of the type locality of *M. mali*. According to the result of these investigations, we conclude that the nematode from Suginami differs not only from *M. mali* on apple in Nagano and on mulberry in other localities in the morphological characteristics and the host range but also can be distinguished from any other described species of the genus by some morphological characteristics. Therefore the authors proposed to described this nematode as *Meloidogyne suginamiensis* n. sp. The common name "suginami root-knot nematode" is proposed for this species. *M. suginamiensis* n. sp. has not been detected so far anywhere except the small area in Suginami, where it habits together the less population of *M. mali*, and it is found there on some wild woody and herbaceous plants as well as on mulberry.

The nematode reported as *M. mali* from mulberry and other plants in Suginami by TOIDA in 1979[11] was not the species but seemed to be the present new species.

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Males and second-stage larvae of the nematode for specimens were collected from egg sac on mulberry roots in water, and killed by gentle heat, fixed in TAF, and mounted in the same medium on the slides. Females and eggs obtained from mulberry roots and fixed and mounted in 2% formalin. Females, males and second-stage larvae for type specimens were all fixed TAF and mounted in glycerin after dehydrated in Seinhorst's solution. Perineal patterns were cut in lactic acid and mounted in glycerin.

The nematode specimens for SEM observation were killed in 60℃ hot water for 5 minutes and fixed 2% glutaraldehyde solution with 0.1M sodium cocodylate buffer (pH 7.4) for 72 hours at 5℃. Postfixation with 2% osmic acid solution buffered with 0.1M sodium cocodylate (pH 7.4) for 12 hours at 5℃. And then the specimens dehydrated in a graded series of ethanol, critical point dried from liquid CO_2, sputter-coated with 200 Å layer of gold palladium, and examined with MINI-SEM • MSM4C-202 operated at 10kv.

Parasitism of the nematode on vegetables and mulberry was tested in a greenhouse by inoculation of eggs or newly hatched larvae of the species. While gall formation by this nematode on roots of wild woody plants and weeds in and/or around a mulberry field was surveyed.

MELOIDOGYNE SUGINAMIENSIS n. sp.

(Fig. 1-5)

DESCRIPTION AND MEASUREMENTS

Female (n=15). Length (excluding neck) = 950μm(670-1220), width = 740μm(600-1010), L/W ratio = 1.3(1.0-1.5), neck = 220μm(160-290), stylet = 14μm(12-17), dorsal esophageal grand orifice to stylet base = 4.7μm(3-6), vulval slit length = 20μm(15-24), vulval slit to anus = 20μm(13-28), metacorpus = 41μm(38-46) long and 35μm(33-37) wide, central valve apparatus = 11μm(9-12) long and 8μm(6-9) wide, o = 33(25-45), m = 61(54-66).

(n=8, mounted in glycerin) Length (excluding neck) = 920μm(710-1140), width = 720μm(570-950), L/W raitio = 1.3(1.1-1.4), neck = 210μm(140-260), stylet = 13μm(12-16), dorsal esophageal grand orifice to stylet base = 4.2μm(3-5), metacorpus = 39μm(37-44)long and 33μm(31-35) wide, central valve apparatus = 10μm(9-11) long and 7μm(6-8) wide, o = 34(26-42), m = 59(53-62).

Holotype (female). Length (excluding neck) = 804μm, width = 603μm, L/W ratio = 1.3, neck = 201μm long and 134μm wide at the base, stylet = 14μm, dorsal esophageal grand orifice to stylet base = 3.5μm, metacorpus = 46μm long and 34μm wide, excretory pore located at 34μm from anterior end.

Body pearly white, sometimes yellow brown, usually rather elongate ovoid to pear shaped, with projecting neck and slightly flattened to rounded posterioly. Neck tapering to head tip, being less than one-fourth of body length. Head region small, slightly set off from body. Head cap low, in SEM observation of face view, dumbell-shaped, with labial disc fused to medial lips in the same contour and lateral lips fused to the upper surface of head. Cuticle comparatively thick. Excretory pore generally located posterior to dorsal esophageal gland orifice, being on 22-28th annule and 3-7% of total body length from anterior end. Stylet slender, short, often curved dorsally, with small rounded knobs usually sloping posteriorly. The perineal pattern slightly squarish in outline especially in dorsal arch, with wavy, very fine, thin striae. Lateral line not clear. Phasmids rather large, being 15-28μm(mean 22μm) apart, slightly wider than the length of vulval slit which nearly equals to the distance to anus.

Male (n=20) Length = 1510μm(1040-1770), width = 33μm(26-37), tail = 17μm(13-19), a = 45(40-50), c = 91(59-122), stylet = 20μm(17-21), dorsal esophageal grand orifice to stylet base = 5.4μm(4-8), o = 27(20-40), m = 57(50-65), excretory pore to anterior end = 145μm(110-170), spicules = 32μm(25-37), gubernaculum = 8μm(6-10).

(n=10, mounted in glycerin) Length = 1450μm(1000-1640), width = 31μm(26-35), tail = 15μm(13-17), a = 44(41-48), c = 97(60-115), stylet = 19μm(17-20), dorsal esophageal grand orifice = 5.2

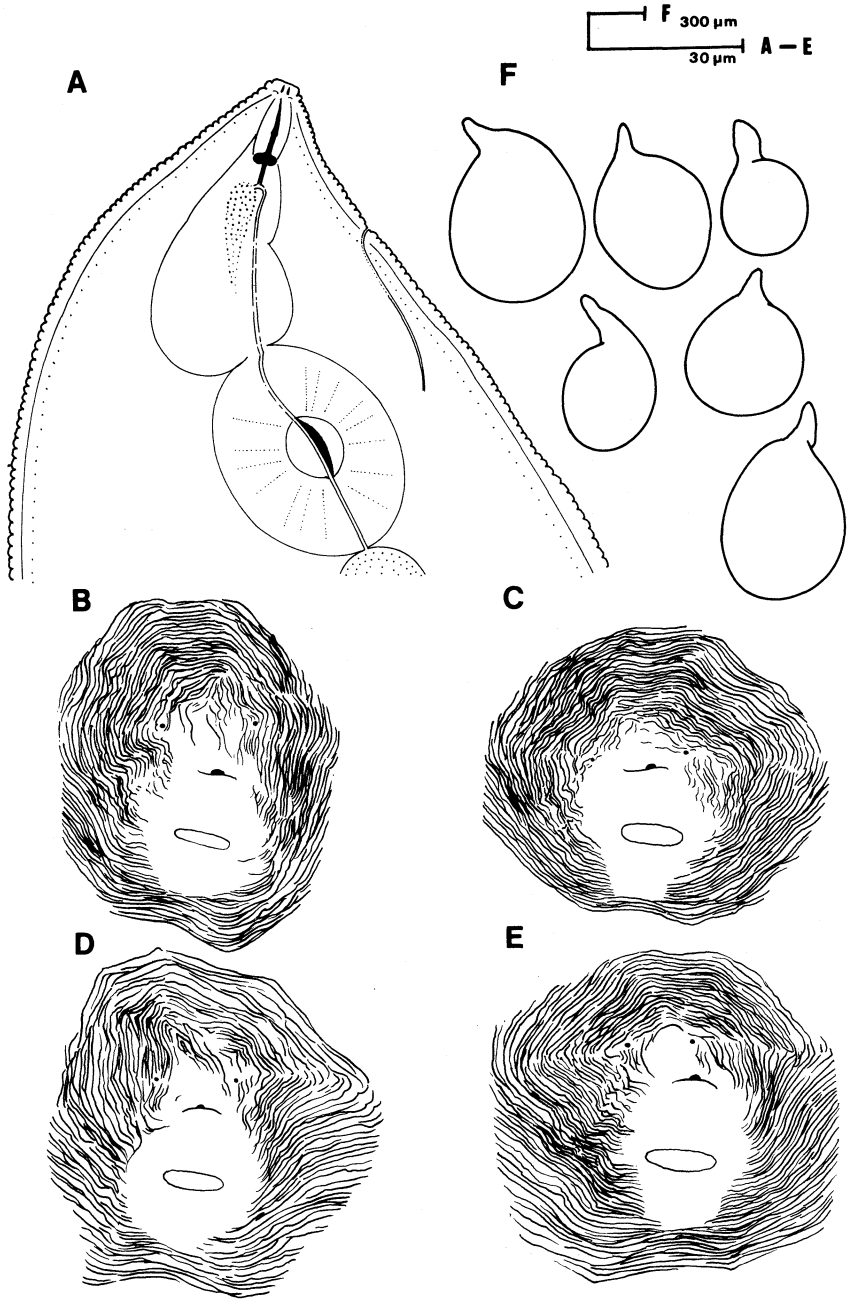

Fig. 1. *Meloidogyne suginamiensis* n. sp. Female. A) Anterior portion. B-E) Perineal patterns. F) General views.

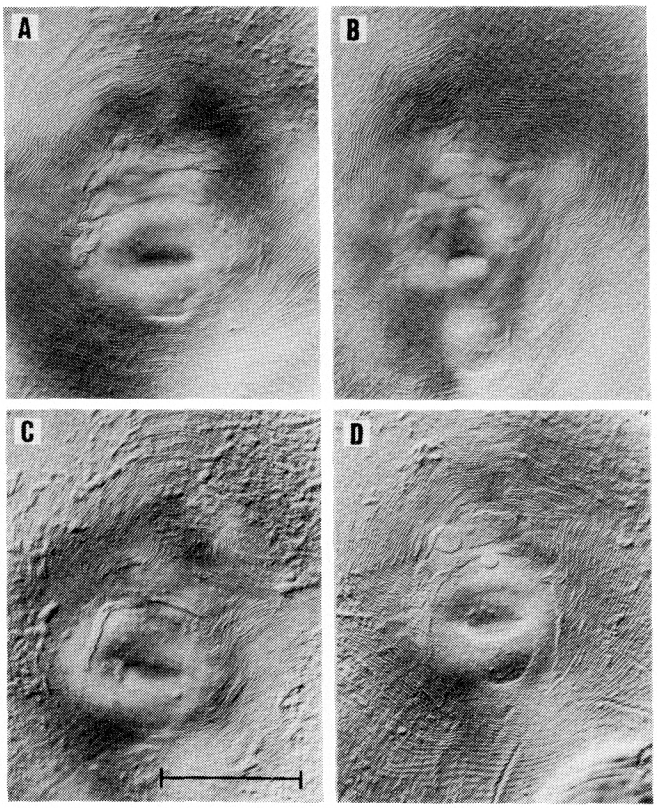

Fig. 2. LM photographs of perineal patterns of *Meloidogyne suginamiensis* n. sp. (A-D, scale 40μm)

μm(4-7), o=28(22-36), m=56(48-61), excretory pore to anterior end=140μm(120-165), spicules=30μm(24-34), gubernaculum=7μm(6-9).

Allotype(male). Length=1426μm, width=34μm, a=42, c=96, stylet=20μm, dorsal esophageal grand orifice to stylet base=6.3μm, excretory pore to anterior end 156μm, spicules=33μm, gubernaculum=8.9μm.

The general structure nearly equals to other species of the genus, *i.e.* body long, slender, tapering rather at both head and tail portion, and being narrower anteriorly. Body almost straight when killed by gentle heat showing twist in posterior portion. Head region squarish, set off from body, with one or two annules, narrower than first body annule. Head cap, slightly prominent, smaller than head region. In SEM observation of face view, labial disc large, lozenge-shaped and lateral lips clear. Lateral field less than one-third of the body width with four incisures areolating in tail portion. Stylet slender with small knobs (4μm wide and 3.5μm high) directed backward. Excretory pore located 18-27 annules posterior to the valve of metacorpus, being 9-12% of body length from anterior end. Hemizonid located one to three annules posterior to the excretory pore, and one or one and half annules long. Labial portion with six lips. Testis single, 550-840μm long extending near the middle portion of body. Spicules rather acuate ventrally. The gubernaculum less than one-third of the spicules length. Tail shorter than width at anus, with rounded broad tip. Phasmids distinct.

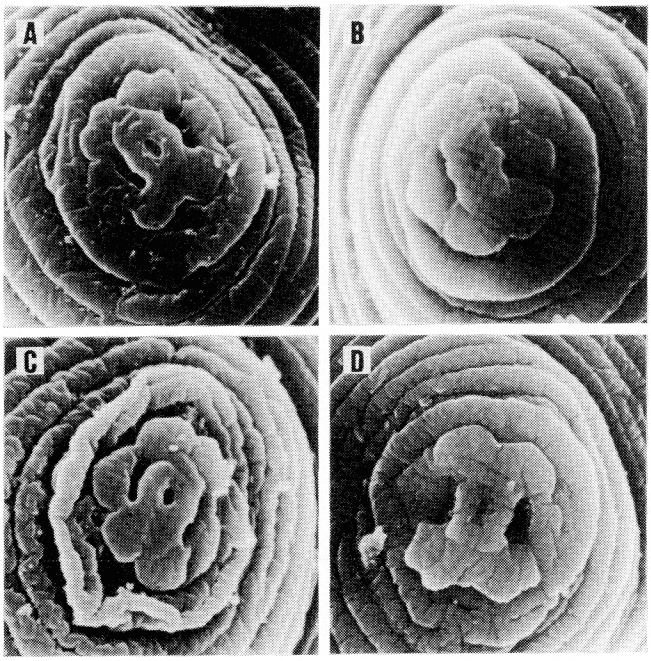

Fig. 3. SEM photographs of female face view of *Meloidogyne suginamiensis* n. sp. (A-D)

Second-stage larvae (n=50). Length=420μm (370-490), width=16μm(14-19), tail=28μm(24-33), a=27(23-29), c=15.8(14.5-18.2), width at anus=8.9μm(8-10), c′=2.9(2.6-3.2), stylet=14μm(12-15), o=31(27-37), m=66(62-71), excretory pore to anterior end=76μm(69-82), dorsal esophageal grand orifice to stylet base=4.1μm(3-5).

(n=15, mounted in glycerin) Length=400μm(340-470), width=15μm(14-17), tail=26μm(24-30), a=26(24-28), c=15.0(14.1-17.3) width at anus=8.5μm(7.5-9.0), c′=2.8(2.7-3.1), stylet=13μm (12-14) o=31(29-35), m=64(61-67), excretory pore to anterior end=72μm(63-80), dorsal esophageal grand orifice to stylet base=3.8μm(3-4).

Body slender, tapering at the both head and tail portion being narrower posteriorly, and cuticular annulation fine but fairly distinct. Lateral field more than one-third of body width, with four incisures, of which outer two slightly crenated, and not areolated. Head slightly set off from body, with thin labial cap. In SEM observation of face view, the labial disc round, fused to the medial lips in the same contour forming a dumbell-shape, and lateral lips never fused to the medial lips in the same contour. Stylet delicate, with small knobs sloping backward. Excretory pore located 17-20% (mean 17.9) of body length from anterior end. Hemizonid not distinct, four to seven annules posterior to the excretory pore. Tail conoid, short, deeply constricting usually at one-third of tail length from terminus, with rounded, blunt tip. Hyline tail terminus length short (3-5μm).

Egg (n=50) Length=92μm(83-100), width=40μm(37-43), L/W ratio=2.3(1.9-2.6).

TYPE HOST AND LOCALITY

Specimens collected from roots of mulberry (*Morus alba*) in Wada, Suginami-ku, Tokyo, where the Sericultural Experiment Station formerly situated.

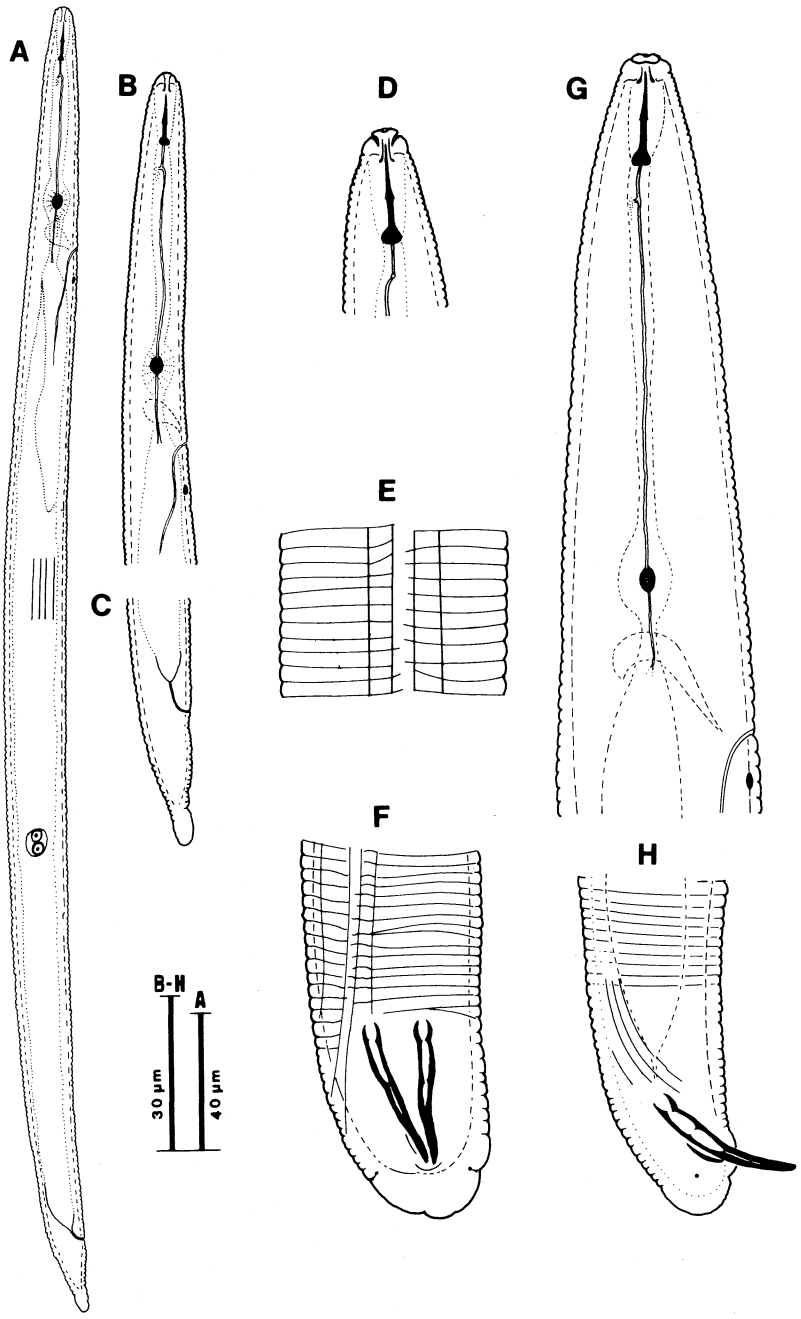

Fig. 4. *Meloidogyne suginamiensis* n. sp. Second-stage larvae. A) Entire body. B) Anterior portion. C) Posterior portion. Male. D) Anterior portion (dorsal view). E) Lateral field. F) Posterior portion (dorsal view). G) Anterior portion. H) Posterior portion.

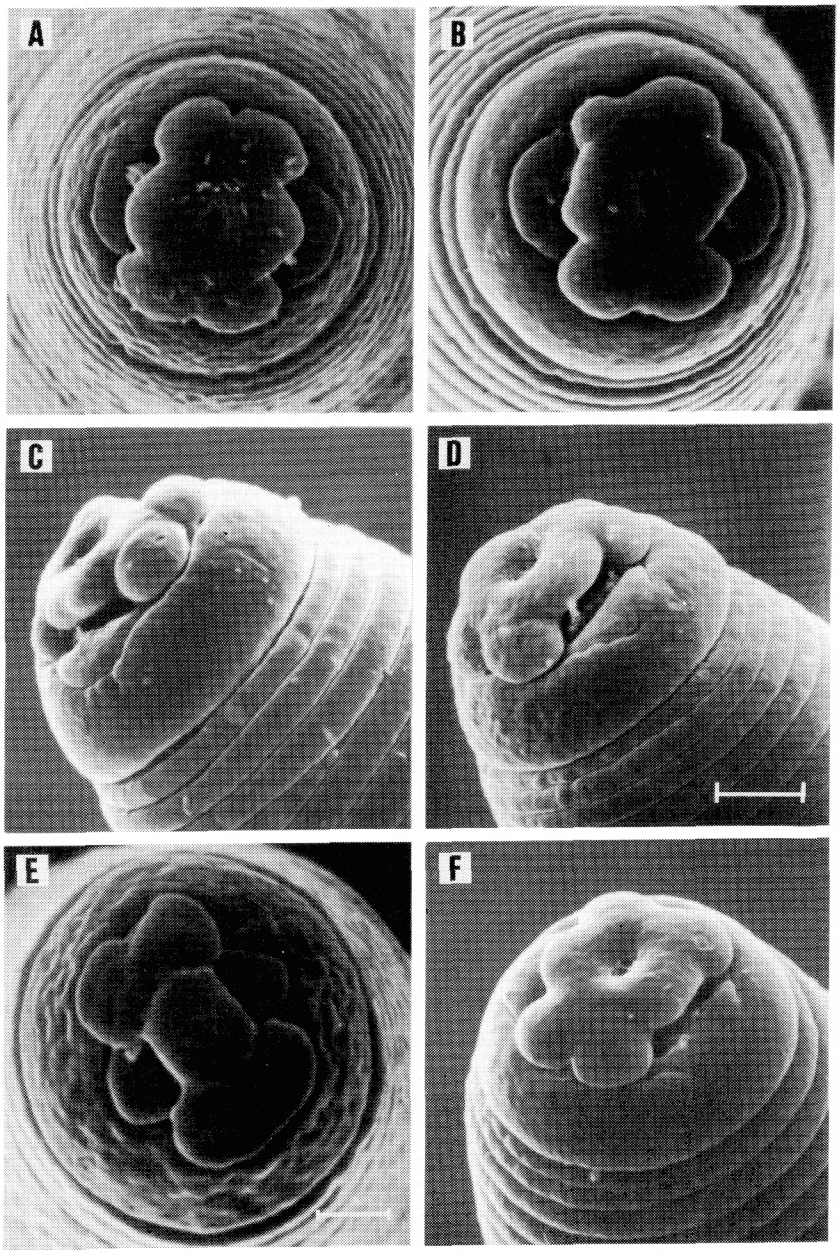

Fig. 5. SEM photographs of head portion of *Meloidogyne suginamiensis* n. sp. A-D, F) Face and lateral views of males. E) Face view of second-stage larva. (A-C, F same scale as D indicating 5μm and E, 2μm).

TYPE DEPOSITION

Holotype female mounted on slide 841, allotype male on slide 842 and paratype females, perineal patterns, males and second-stage larvae on slides 843-849. All slides deposited in the Herbarium and Insect museum of the National Institute of Agro-Environmental Science, Kannondai, Yatabe, Tsukuba, Ibaraki.

DIAGNOSIS

Meloidogyne suginamiensis n. sp. most resembles *M. mali* in the perineal pattern having fine, thin striae and short tail of the second-stage larvae, but it can be distinguished from the latter by the rather squarish outline and wavy striae of the perineal pattern of female, and the more blunt, shorter tail with deeply constricted, rounded terminus of the second-stage larvae. This species also differs from *M. mali* in the hemizonid of males located posterior to excretory pore (hemizonid located anterior to excretory pore in *M. mali*), and in the parasitizing to a good many kind of vegetables and weed plants (*M. mali* is parasitic to only white clover among herbaceous plants in the original description). *M. suginamiensis* n. sp. differentiates from *M. mali* in males face view possessing a lozenge-shaped labial disc and clear lateral lips (a oval labial disc and absent or obscure lateral lips in *M. mali*). Although males of *M. nataliei*[2] also have lateral lips, *M. suginamiensis* n. sp. differs from it by the lozenge-shaped labial disc fused to the medial lips (the round labial disc not fused to the medial lips consisting of four distinctly separated lips in *M. nataliei*). The face view of the second-stage larvae of *M. suginamiensis* n. sp. also differs from that of *M. mali* in a round labial disc and lateral lips never fused to the medial lips in the same contour (the labial disc oval and the lateral lips fused to the medial lips in the same contour in *M. mali*). Tail shape of second-stage larvae of *M. suginamiensis* n. sp. is similar to those of *M. artiellia*[1], *M. coffeicola*[7], *M. inornata*[6], *M. kikuyensis*[3] and *M. nataliei*, but it can be separated from these species except *M. artiellia* in larger c-value (15.8 *vs.* 11-13 in other four species), and from *M. artiellia* (c-value 14.3) by its hemizonid situated posterior to excretory pore (hemizonid anterior to excretory pore in *M. artiellia*) and shorter hyaline tail terminus length[5] (3.5μm *vs.* 6.8μm in *M. artiellia*).

ADDITIONAL HOST PLANTS

Woody plants : Mulberries(*Morus bombycis, M. latifolia, M. australis, M. nigra*), elm(*Ulmus davidiana* var. *japonica*), fig (*Ficus carica*), paper mulberry (*Broussonetia kajinoki*), *Broussonetia papyrifera, Cudrania tricuspidata,* raspberry (*Rubus* sp.) and cherry (*Prunus yedoensis*).

Weed plants : *Achyranthes japonica*, sorrel vine (*Cayratia japonica*), ink-bush (*Phylolacca americana*), goose foot (*Chenopodium ficifolium*), yellow cress (*Rorippa indica*) and a bad smelling plant (*Paederia scandens*).

Vegetable plants : Tomato (*Lycopersicon esculentum*), egg plant (*Solanum melongena*), pepper (*Capsicum annuum*), cucumber (*Cucumis sativus*), pumpkin (*Cucurbita* sp.), cabbage (*Brassica oreracea* var. *capitata*), great burdock (*Arcutium lappa*) and carrot (*Daucus carota* var. *sativa*).

We wish to thank late Koichi OKAMOTO, National Institute of Agriculture Scince, for his valuable suggestions about this study, and we are also grateful to Mr. Y. ITOH, Nagano Fruit Tree Experiment Station, for his help in collecting materials.

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和文摘要

日本産クワから検出されたネコブセンチュウの新種の記載

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東京都杉並区の旧蚕糸試験場跡地のクワから検出されたネコブセンチュウを未記載種と認め，*Meloidogyne suginamiensis* n. sp.と命名した。本種は雌の会陰紋の条溝がきわめて繊細で，浅いことや2期幼虫の尾長がわが国で知られている本属の中ではきわだって短いなどの特徴から，これまで*M. mali*とみなされてきた。しかし，本種の雌の会陰紋はやや角張り，背部条溝に起伏が認められる，雄の半月体は排泄口の後方に位置する，2期幼虫の尾はより短かく，深いくびれが認められ，先端は丸く，太いなどの特徴から*M. mali*と区別される。また，*M. suginamiensis* n. sp.はイノコズチ，トマトなどかなり多種の草木に寄生することから，シロツメクサ以外の草本には寄生しないとされる*M. mali*とは異なる。さらに，本新種は雄成虫が菱形状の，また2期幼虫が長円形のそれぞれlabial discをもつことによって，*M. mali*と区別される。本種の2期幼虫の尾の形状は*M. artiellia, M. coffeicola, M. inornata, M. kikuyensis, M. nataliei*などと類似するが，c値およびc′値に差異が認められるほか，雌の会陰紋の形状によってこれらの種とは明らかに区別される。本新種はこれまで上記の旧蚕糸試験場跡地以外の地域からは検出されていない。本種の和名をスギナミネコブセンチュウとすることを提案する。